LIM with TIFUUN

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Today's talk
- A Quick Demo of Map Making with gateau
- Detectability of LIM Power Spectrum

Tomorrow's talk
- Simulation and emission models for LIM mock
- How to Compute Power Spectrum
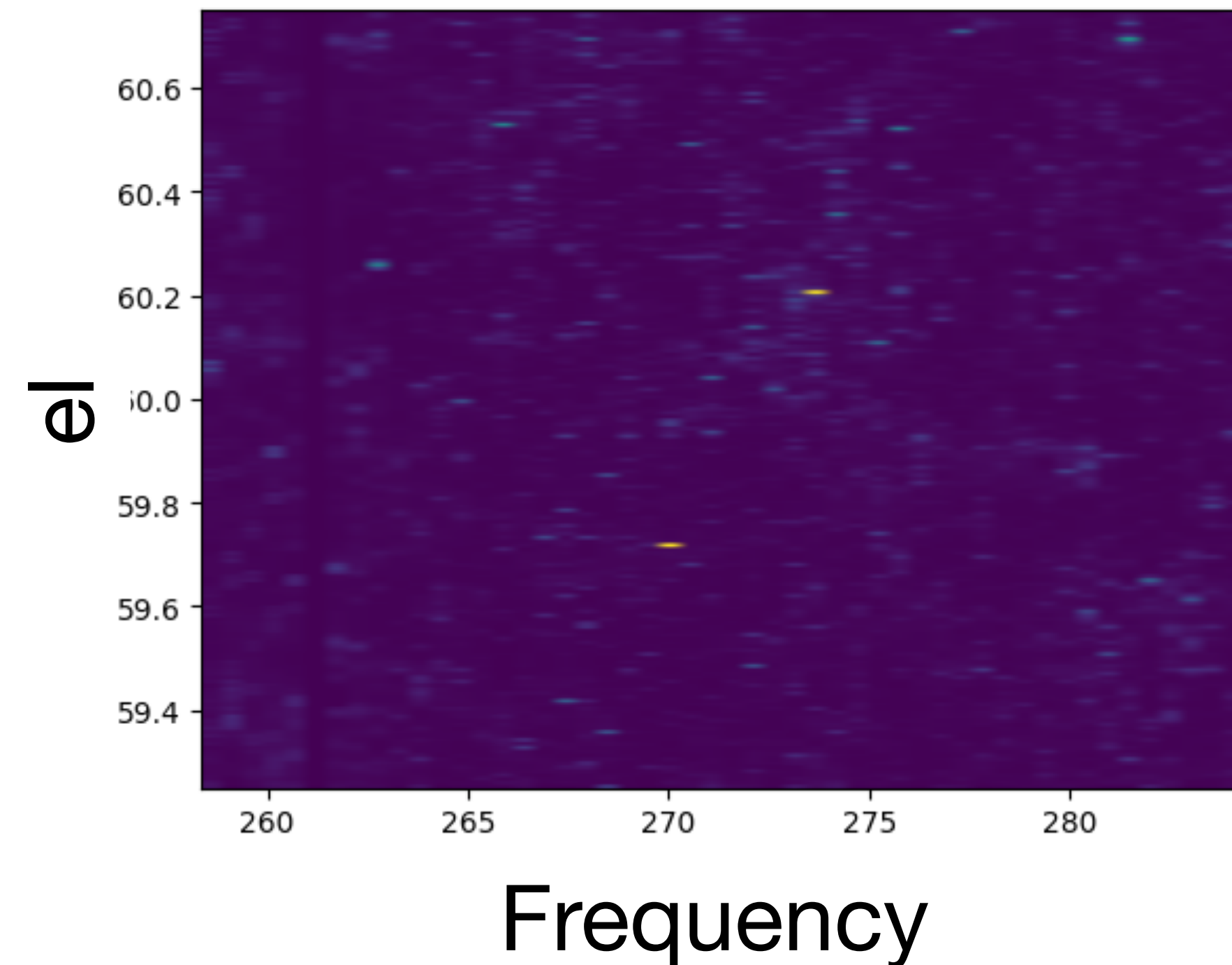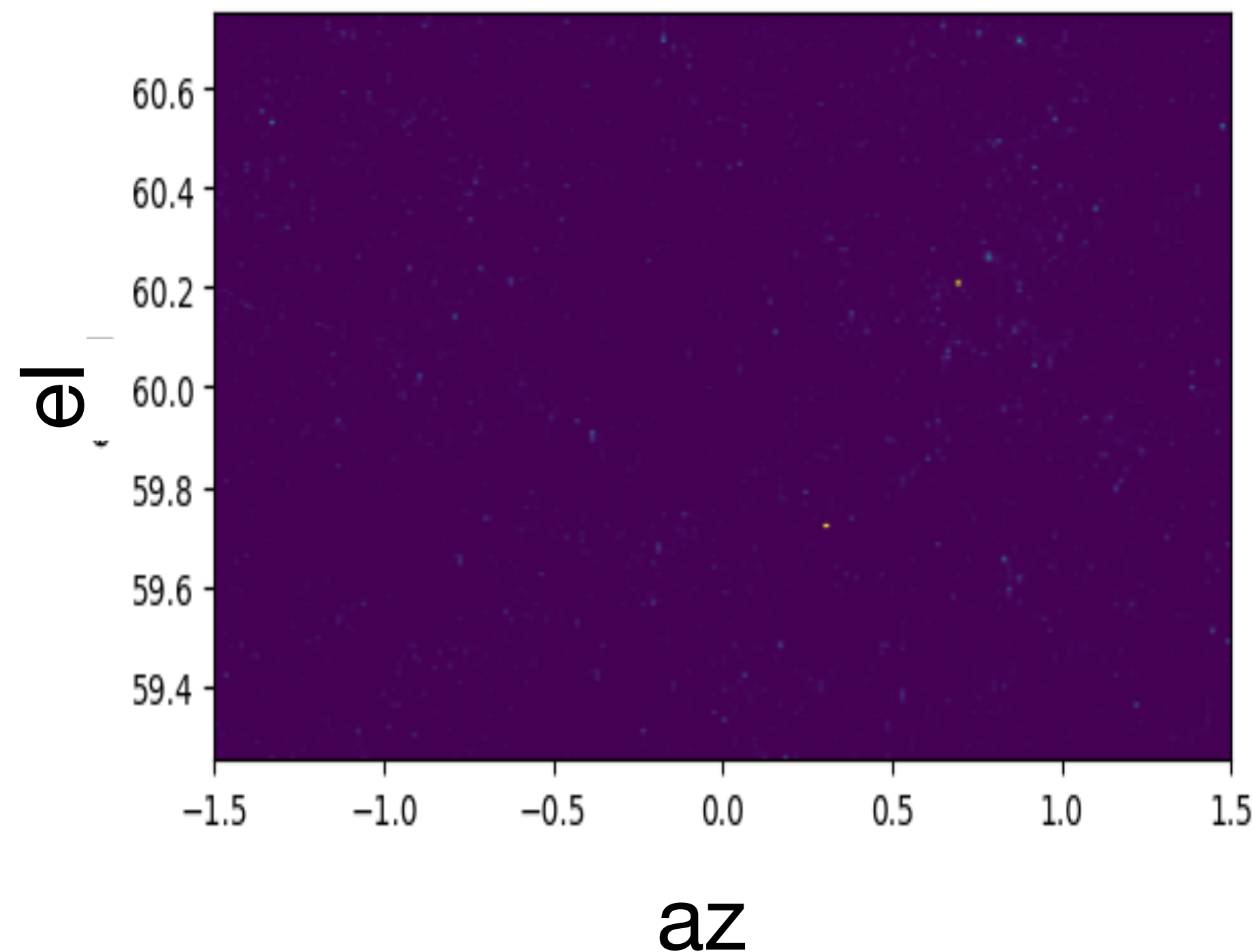- Future prospects (what if we have a much better mapping speed?)

A Quick Demo of Map Making with gateau

- Step 1: Prepare source data cube
- Step 2: Scan
- Step 3: Map Making
- Step 4: Foreground Removal

Step 1: Prepare source data cube

- Mock creation — I'll talk tomorrow
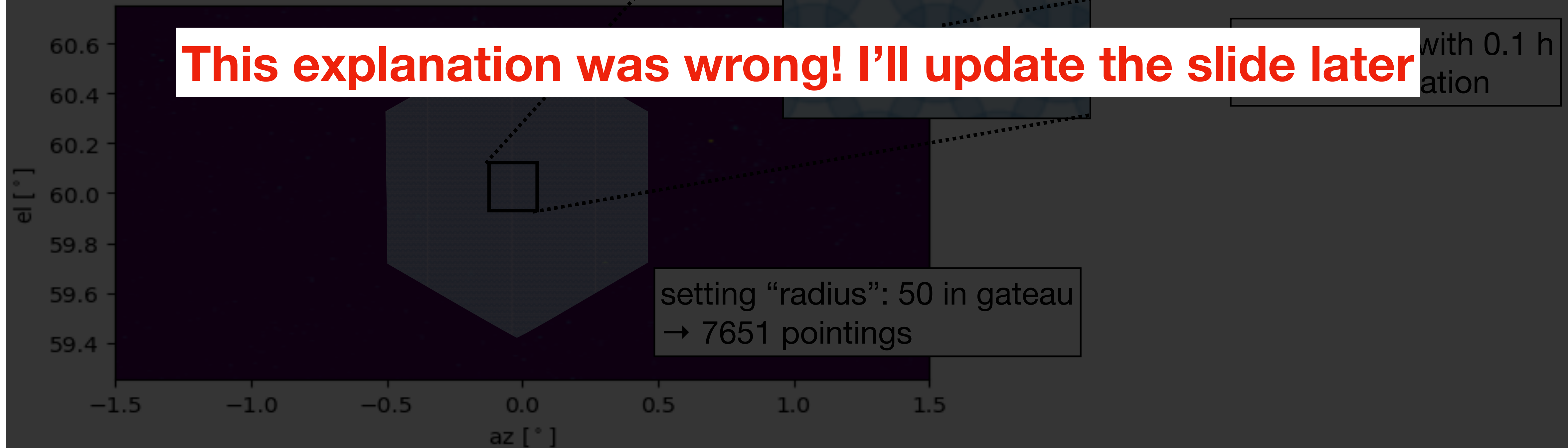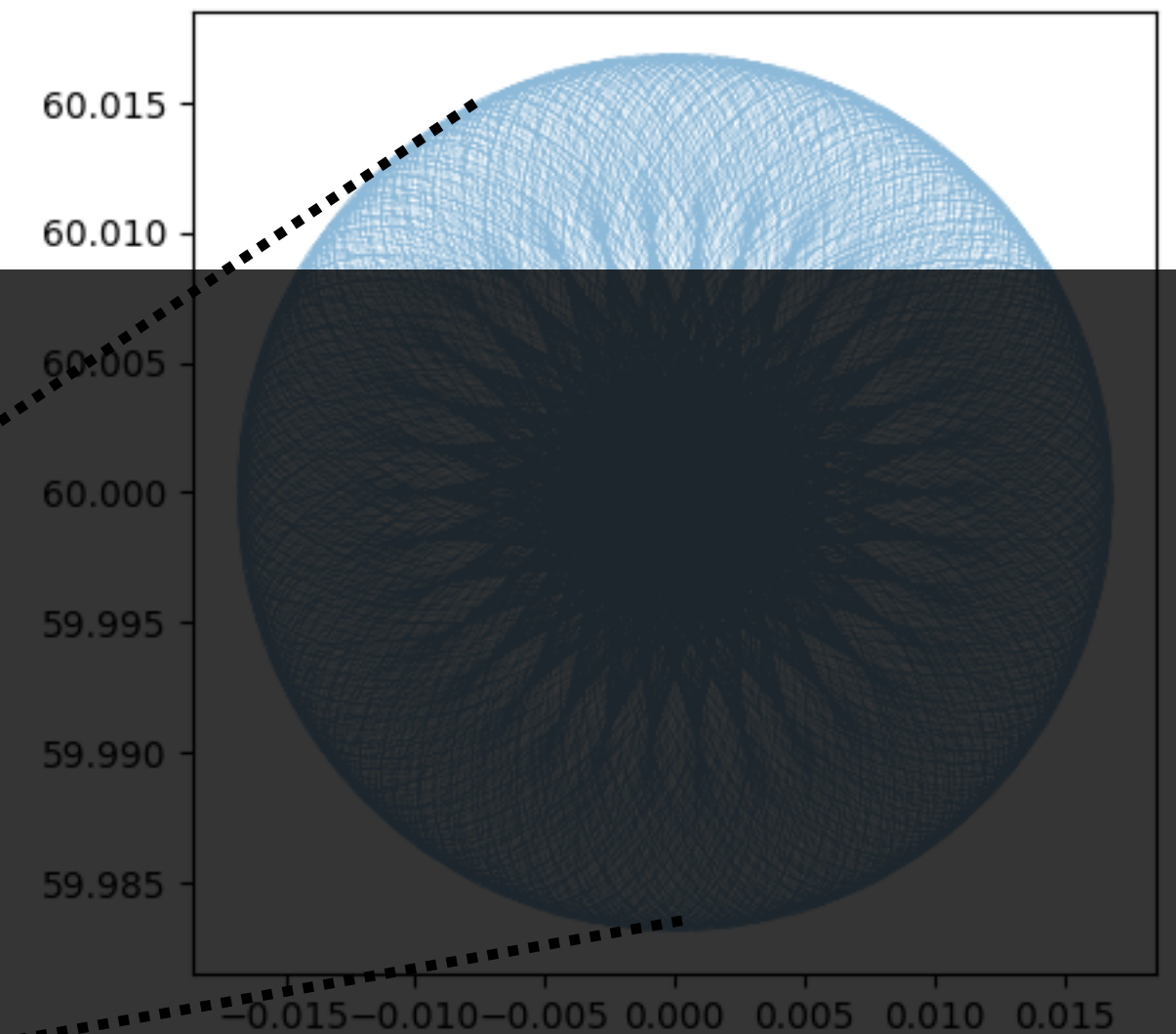- Convert x, y → az, el (flat approximation for now)
- Convolution
  `gateau.source_utils.convolve_source_cube`

Step 2: Scan

Q: How to cover a large-volume?
→ For now I chose a brute force setting

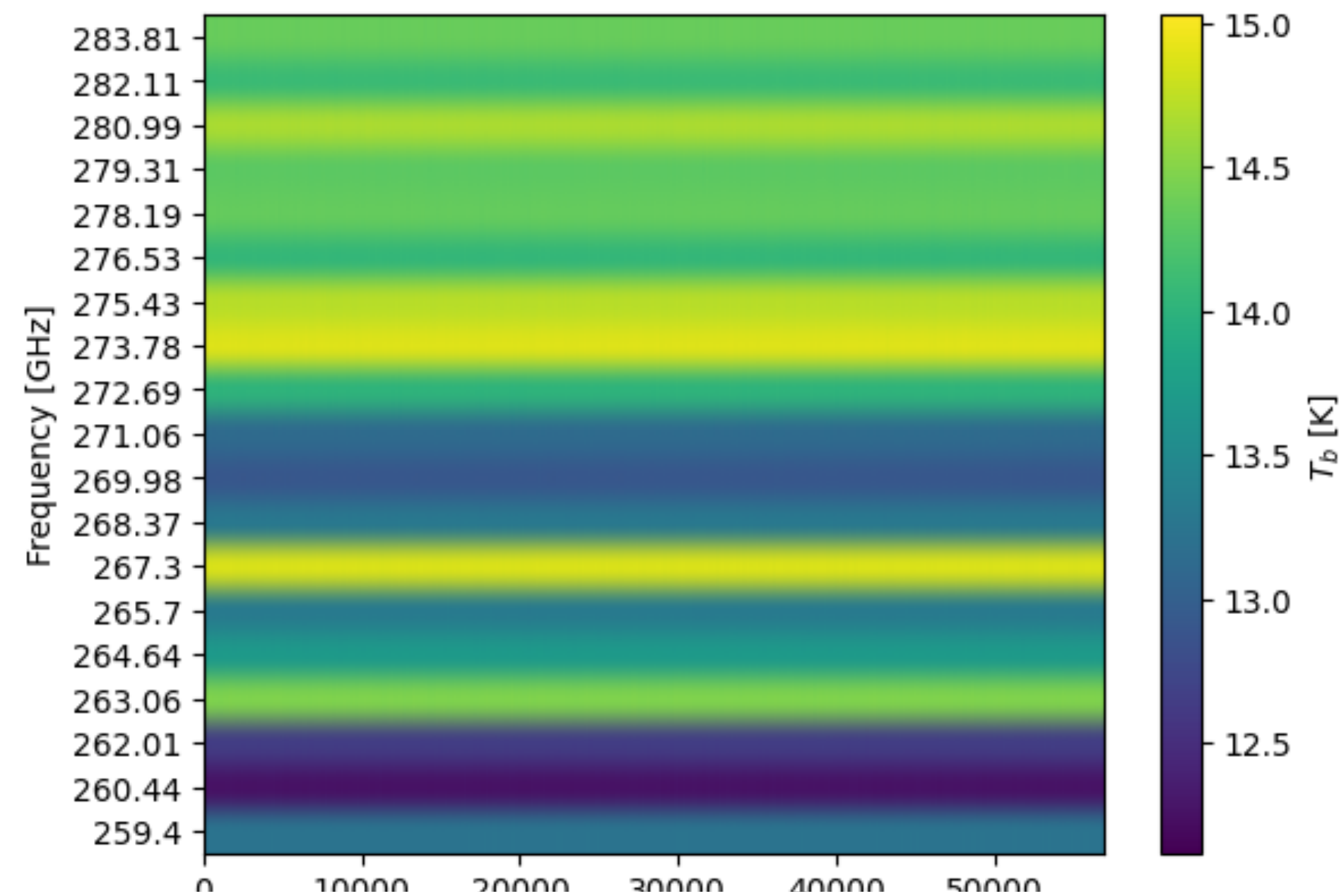This explanation was wrong! I'll update the slide later

with 0.1 h ation

setting "radius": 50 in gateau
→ 7651 pointings

Step 3: Map Making
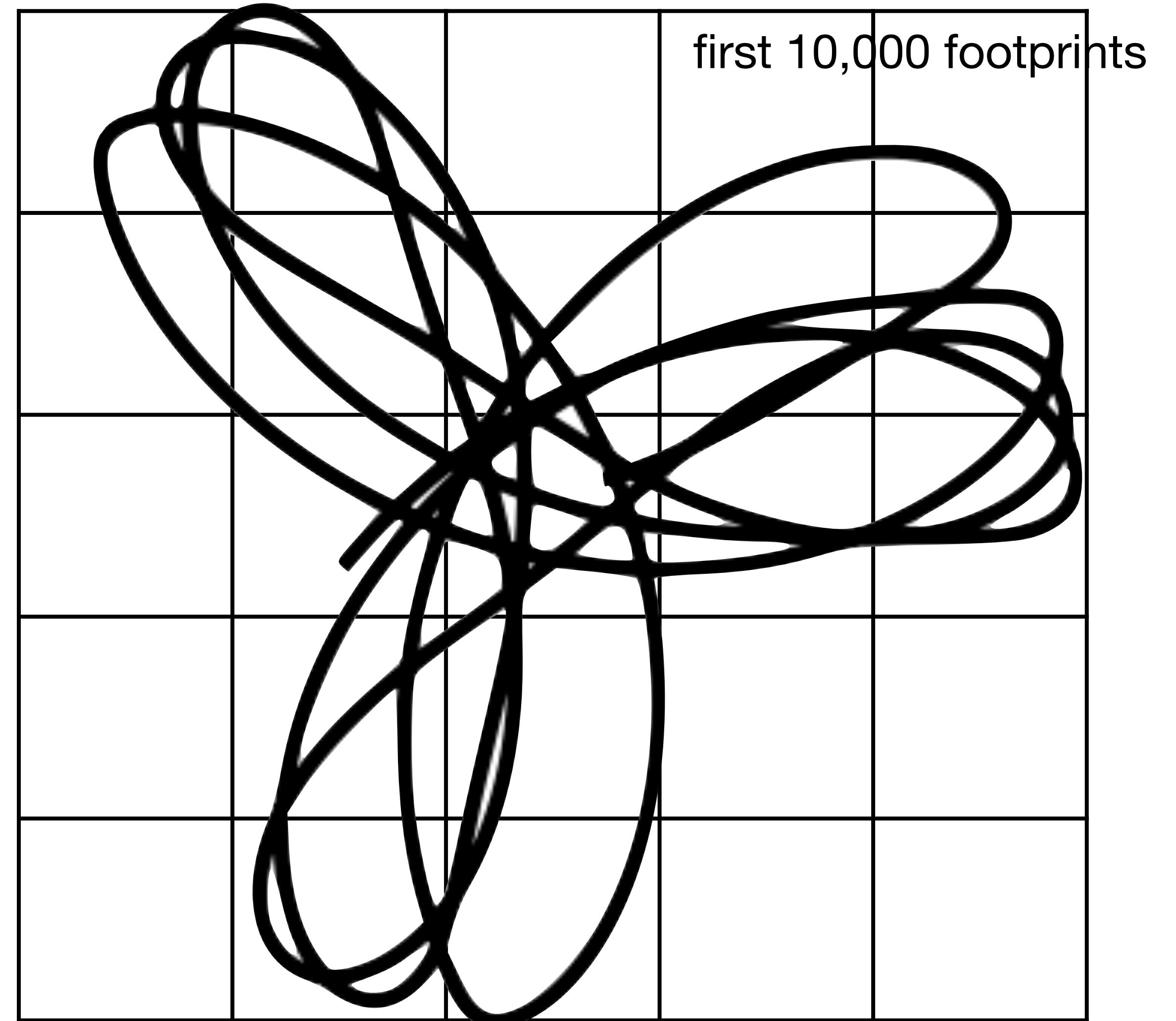
Q. How to deal with time series data?
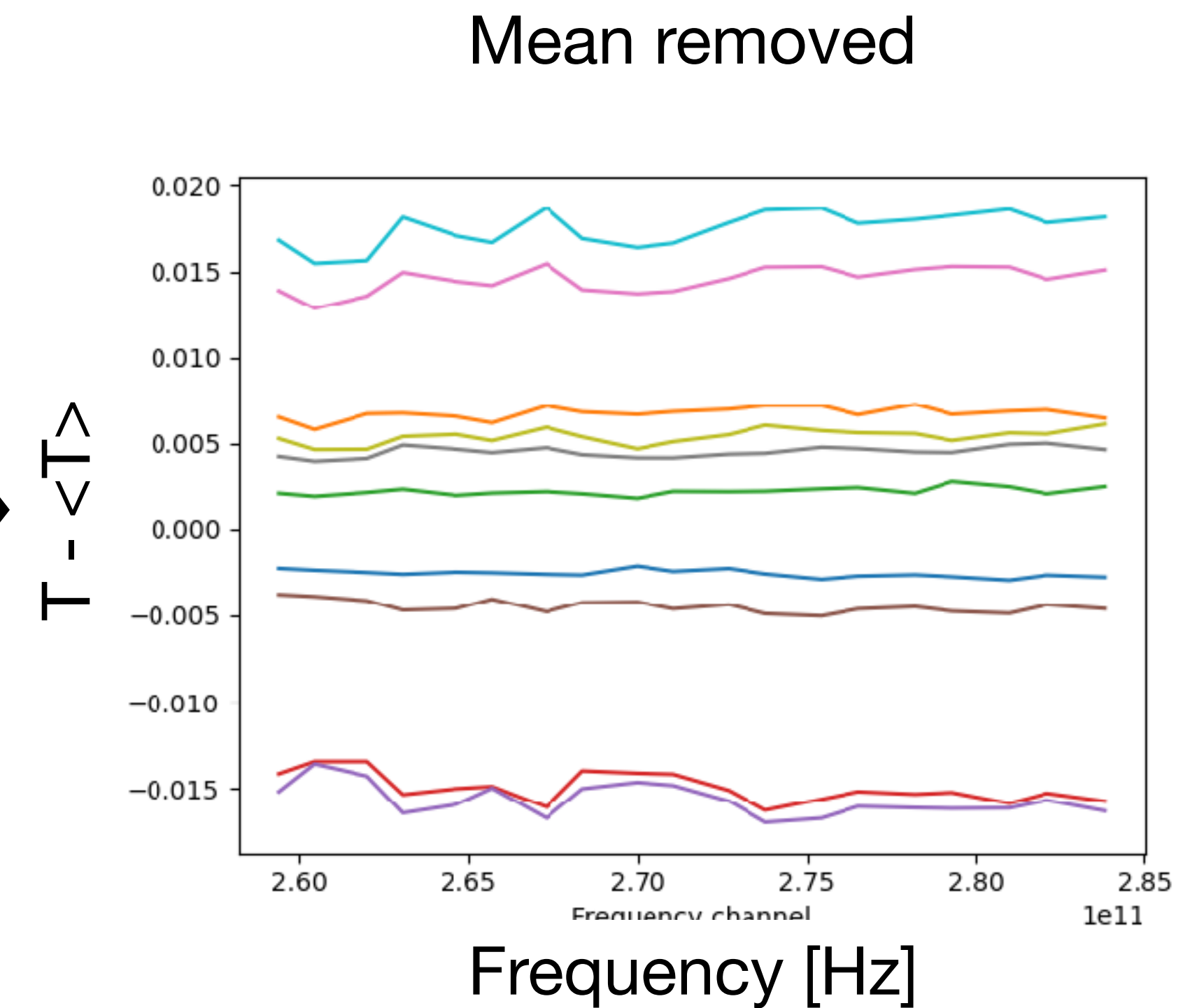→ For now I took the mean temperature in each voxel

first 10,000 footprints

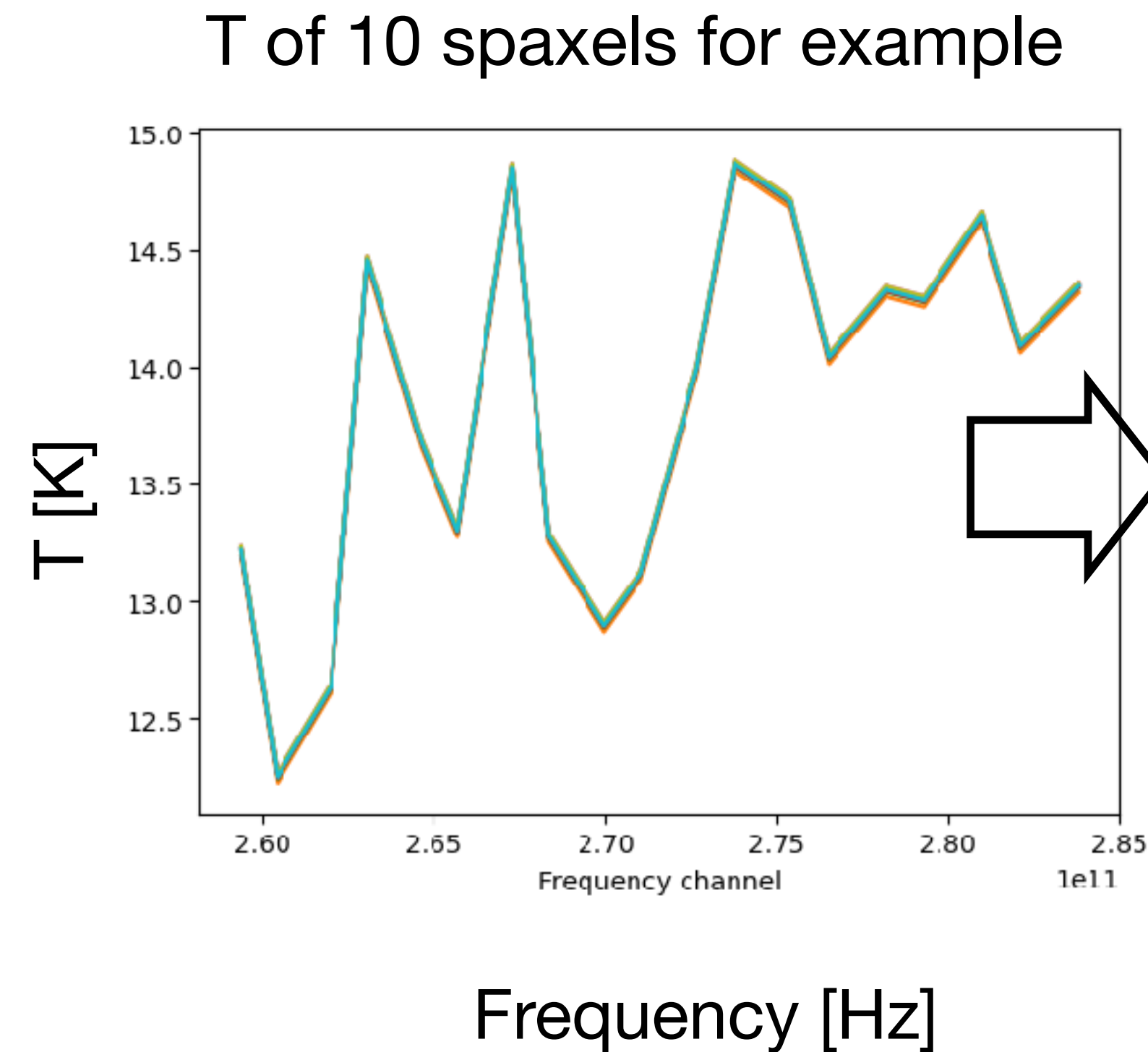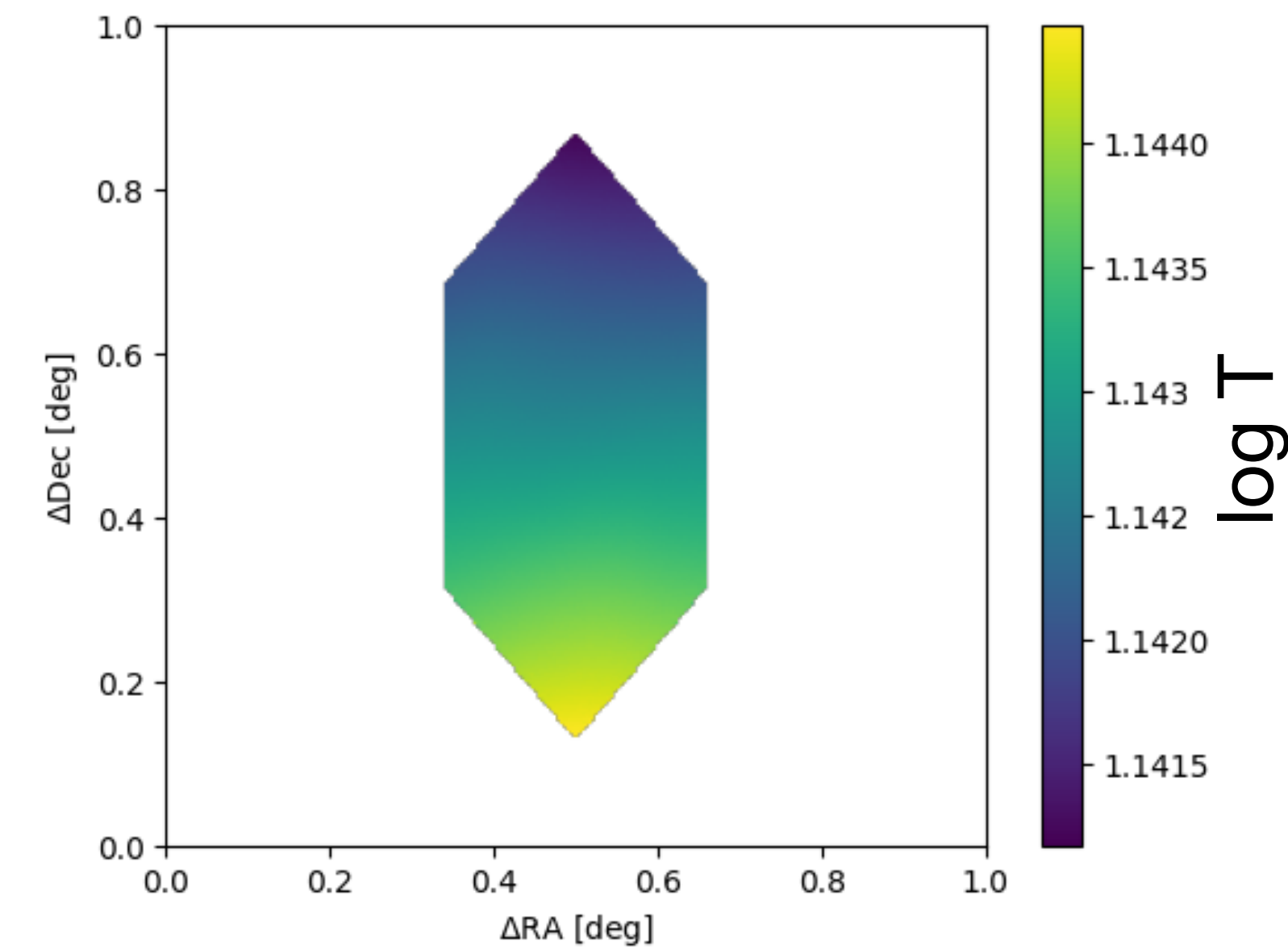↑ **This time fluctuation is for my wrong setup. I'll update this later**

Step 4: Foreground Removal

Q. How to remove the atmosphere and other foreground?
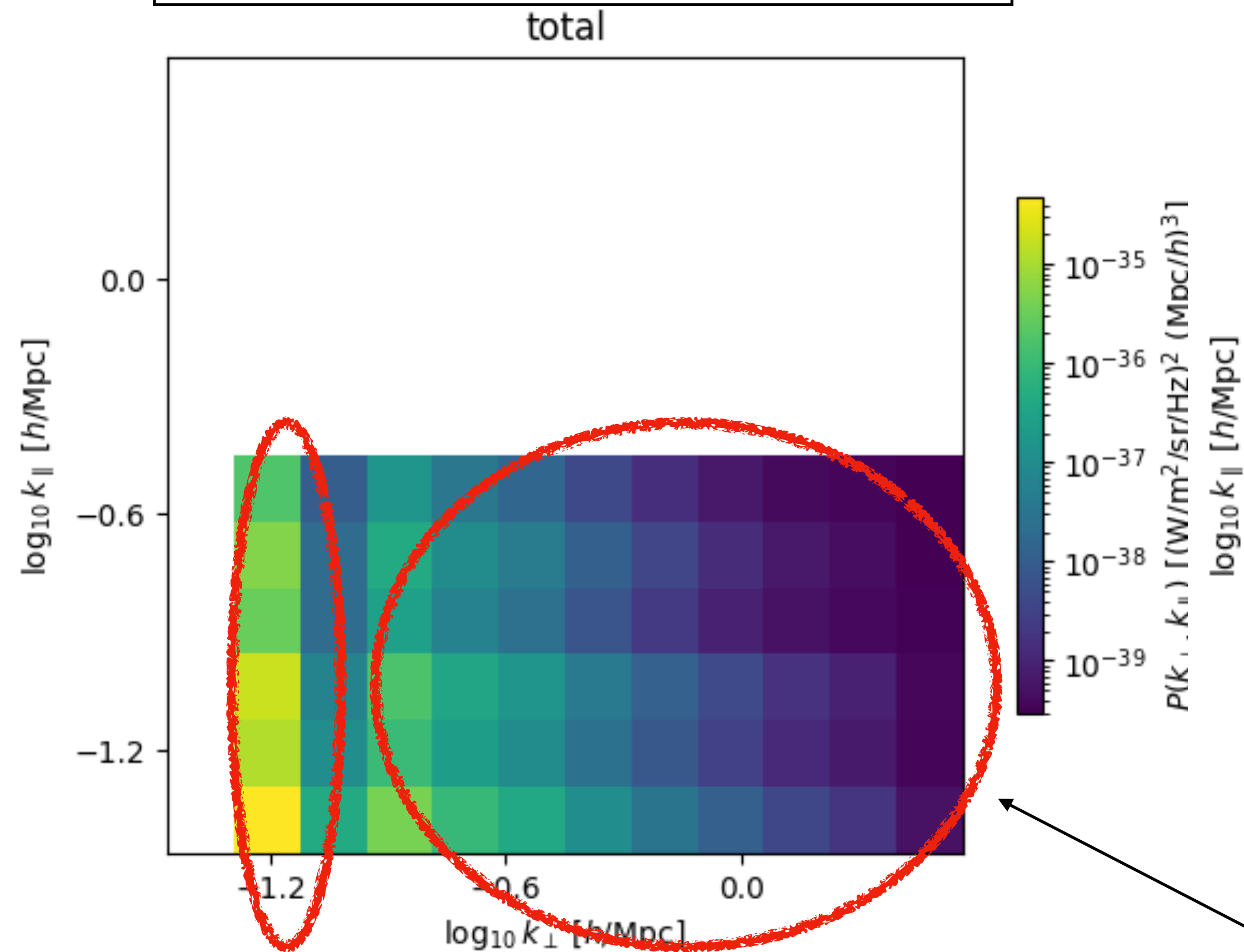→ For now I just removed the frequency-wise mean values

T of 10 spaxels for example

Mean removed

↑ **This figure is not correct.**
   I'll update this later.

Power spectrum with gateau's output

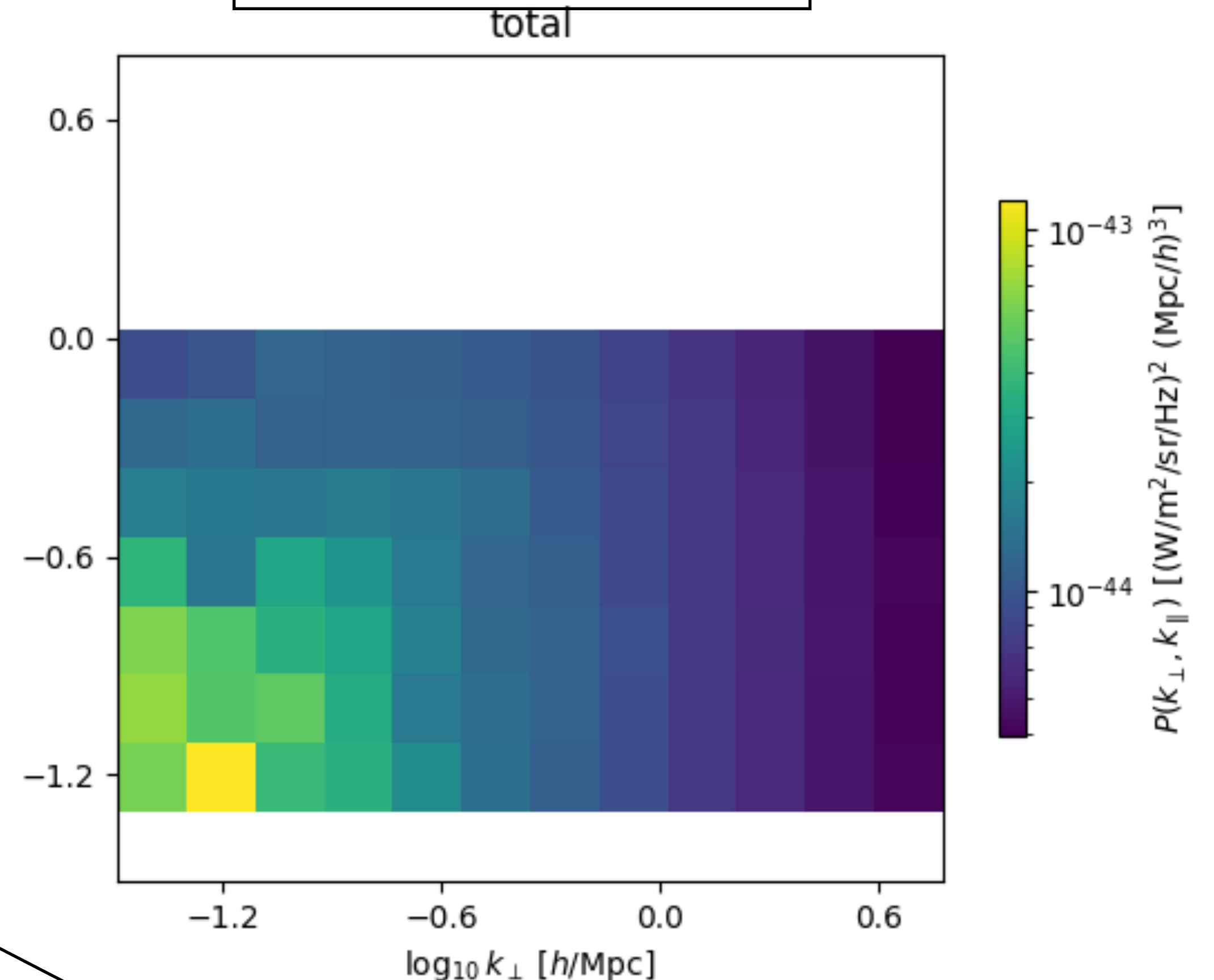I'll talk about map-to-power calculation tomorrow

Power of gateau's output

Cf. signal power

Spatially smooth component

~~Dominated by random noise term? (can't tell with 0.1h integration)~~

Probably due to scan/atmosphere?

Questions / TODO

Required for computing transfer
function, testing pipelines, etc.

Create mocks

- How to cover a large volume with gateau?

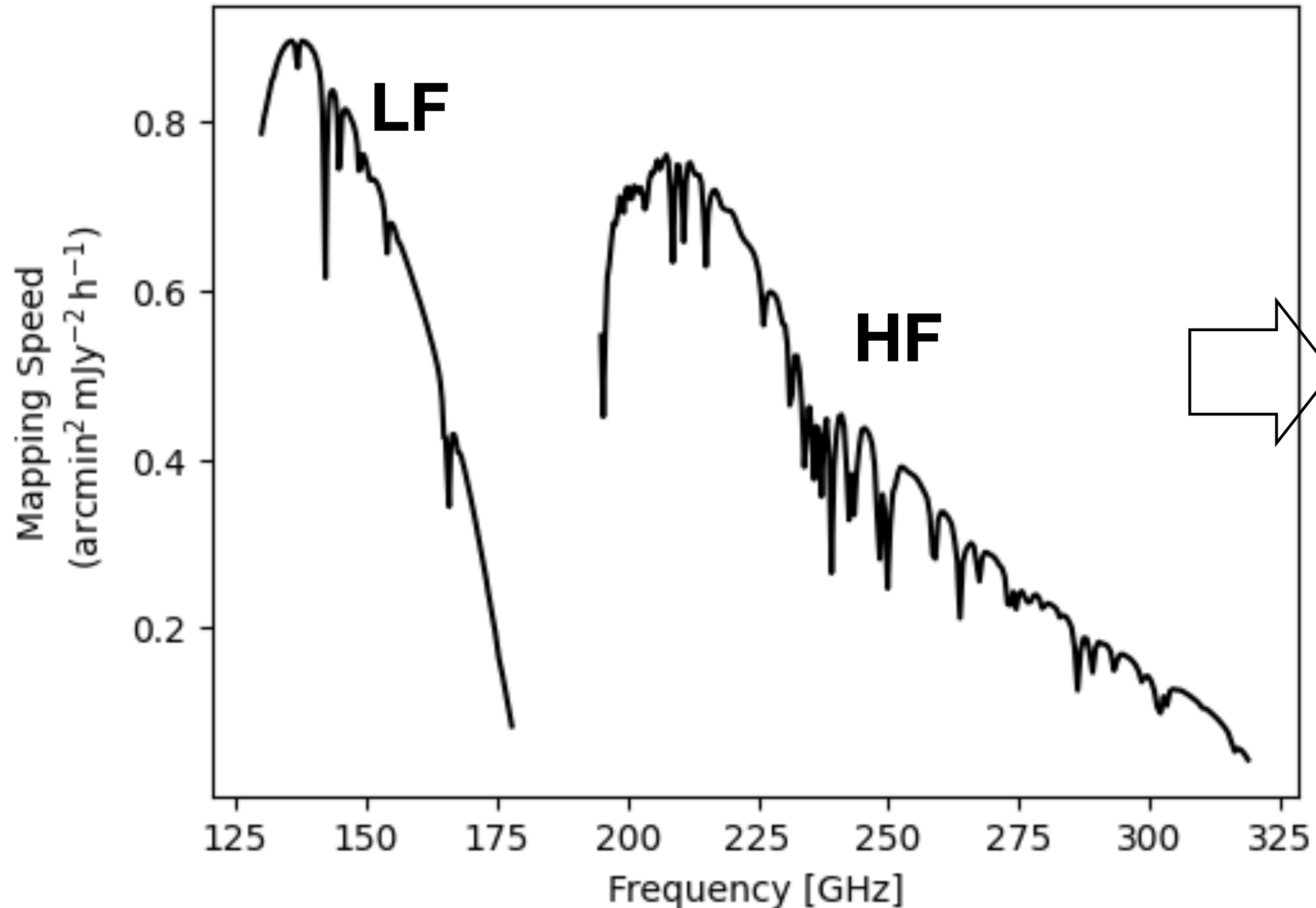- Need more complex atmosphere model or not?

Observational data analysis

- How to deal with time series data?

- How to remove the atmosphere and other foreground?
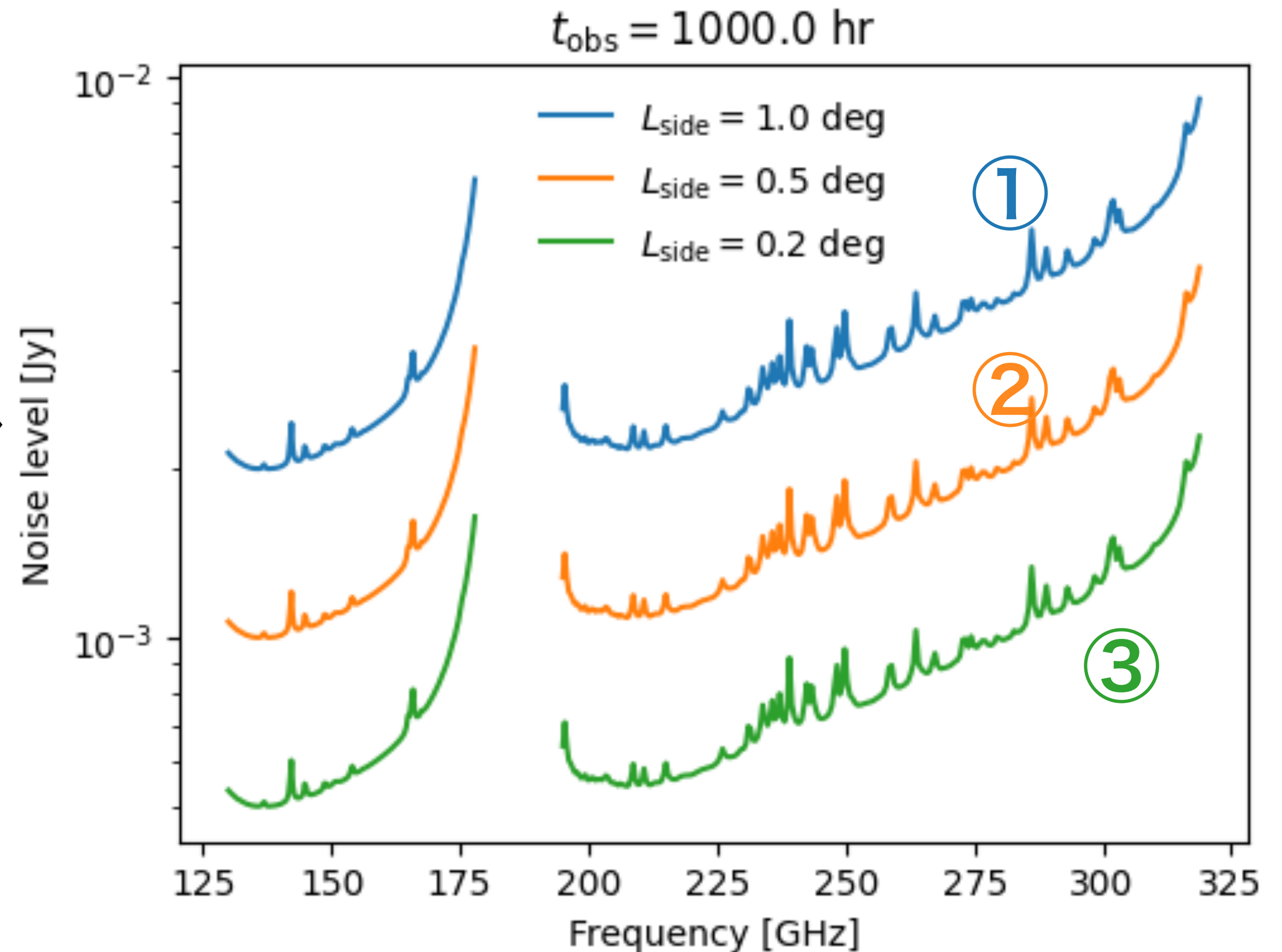
Detectability

Noise levels

① 1 deg × 1deg for 1000 h

② 0.5 deg × 0.5 deg for 1000 h

③ 0.25 deg × 0.25 deg for 1000 h

Mapping speed
(computed with Endo-san's notebook)

Observed = Signal + Noise
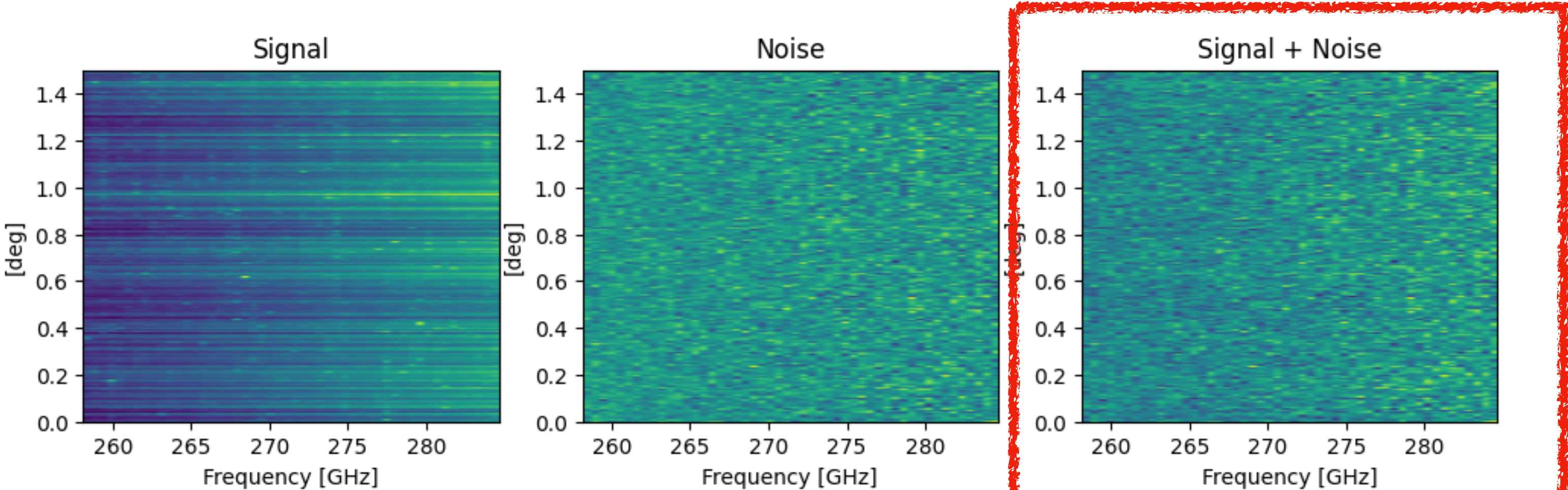
(Details on mock data → tomorrow's talk)

"Observed"

Problem: just taking the auto-power spectrum of the observed data results in a power dominated by noise term

Cross-correlate data at different times

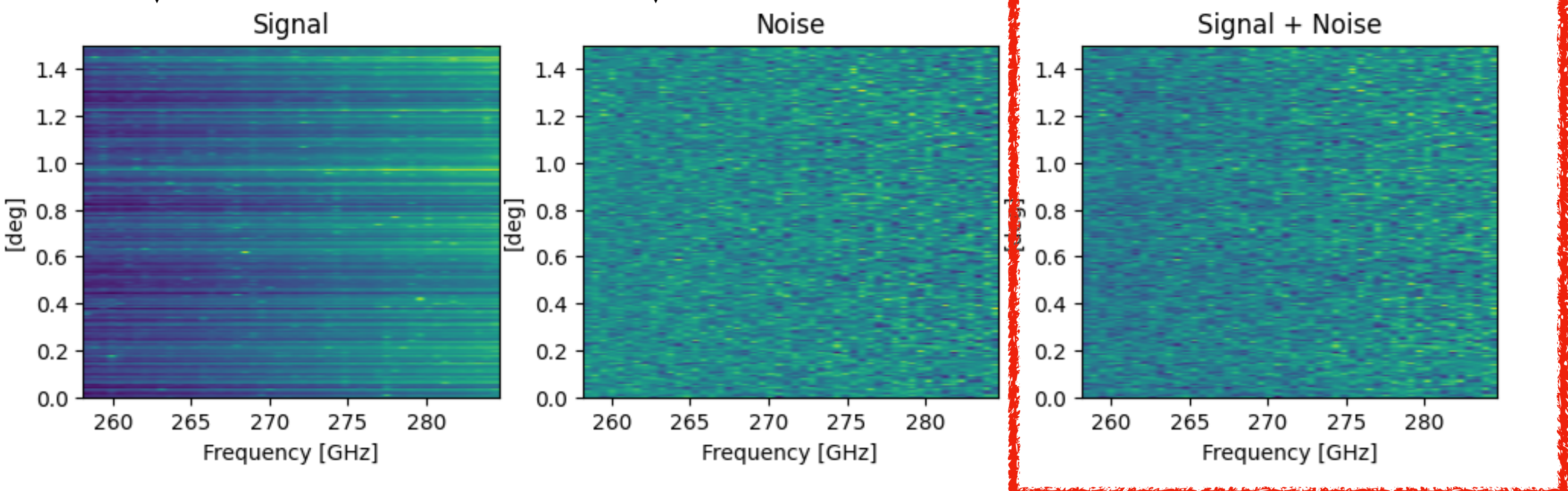**Cross correlation**

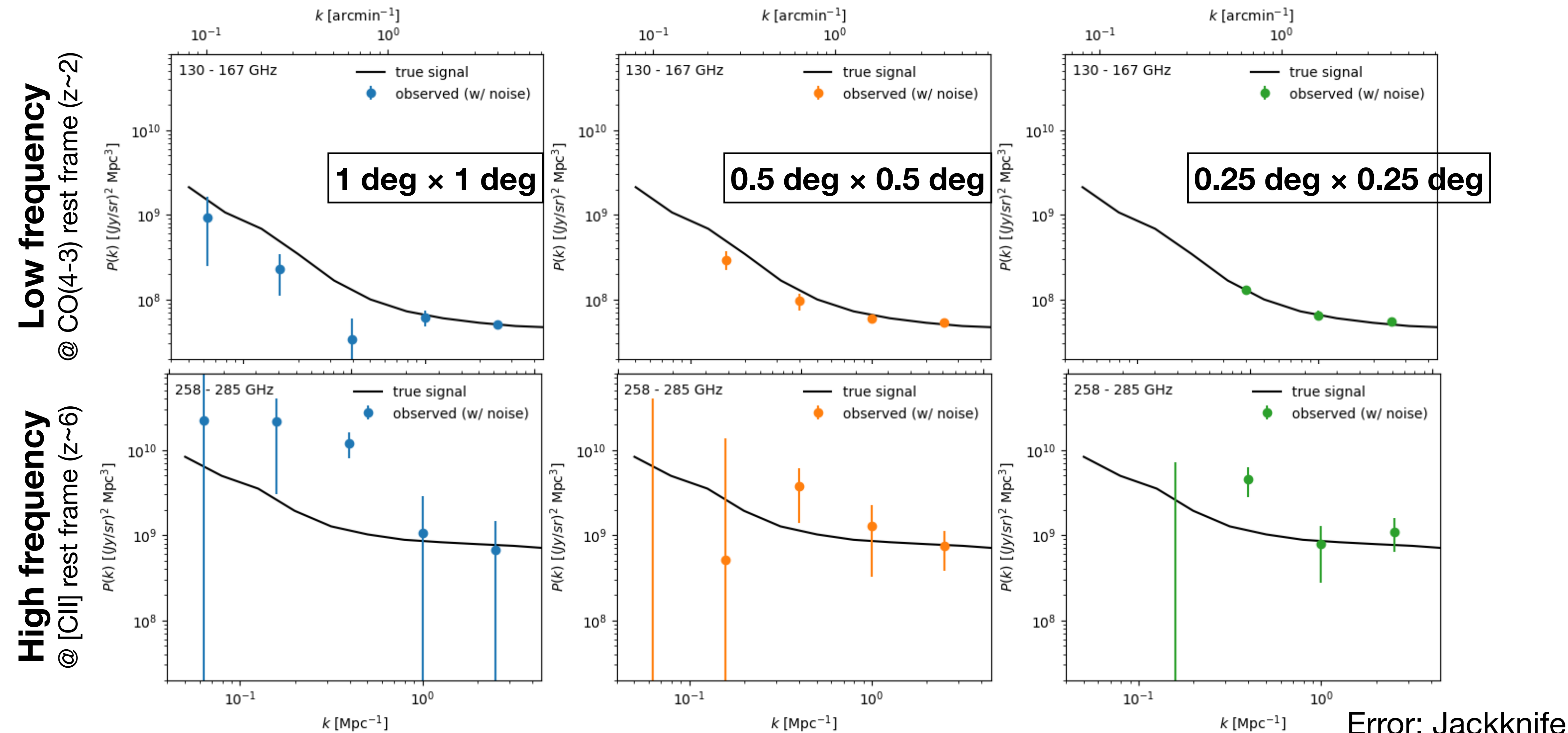time: T_1

time: T_2

Same signal
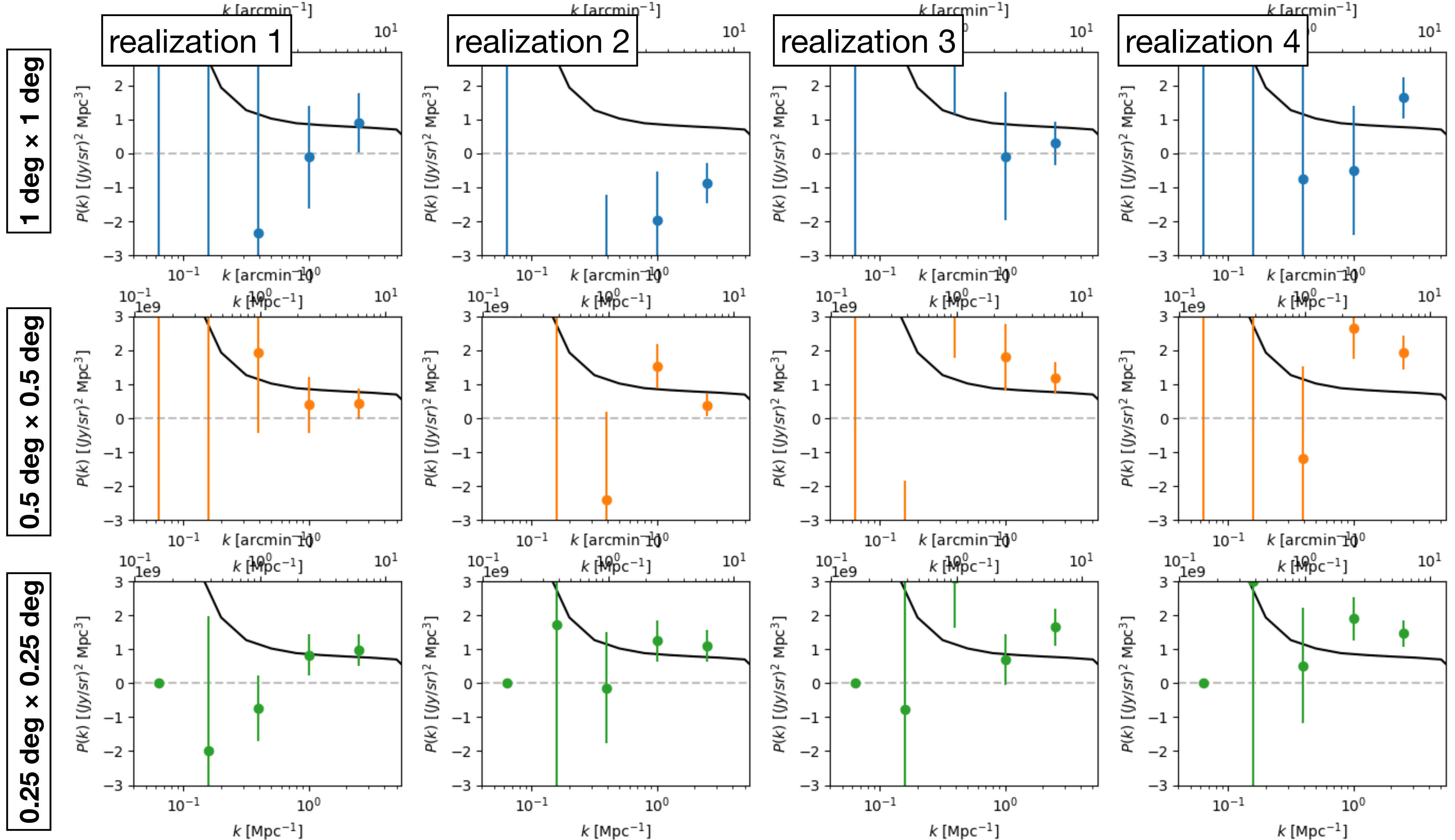
Different noise
→ no correlation

✕

Mock observation result

1 deg × 1 deg
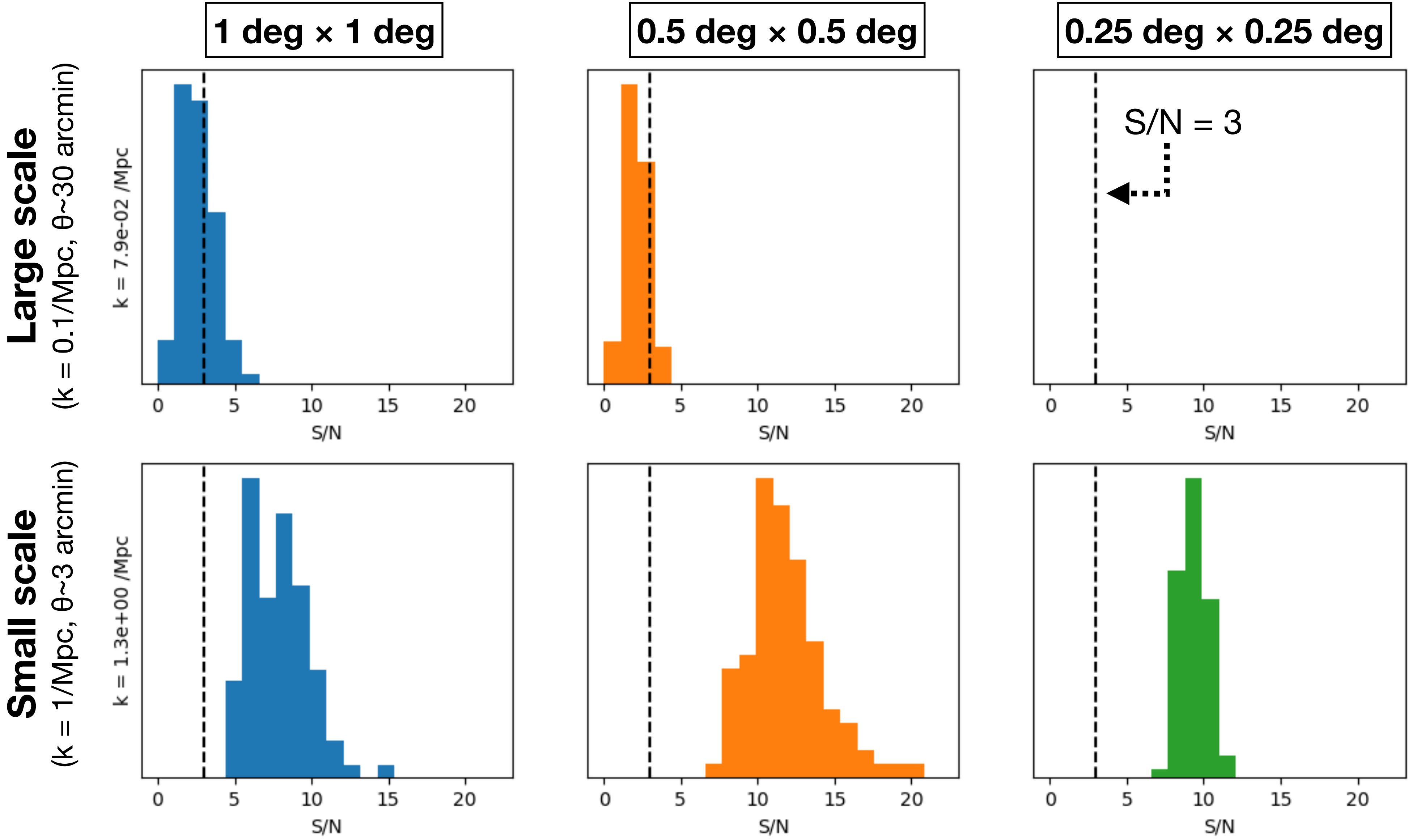
0.5 deg × 0.5 deg

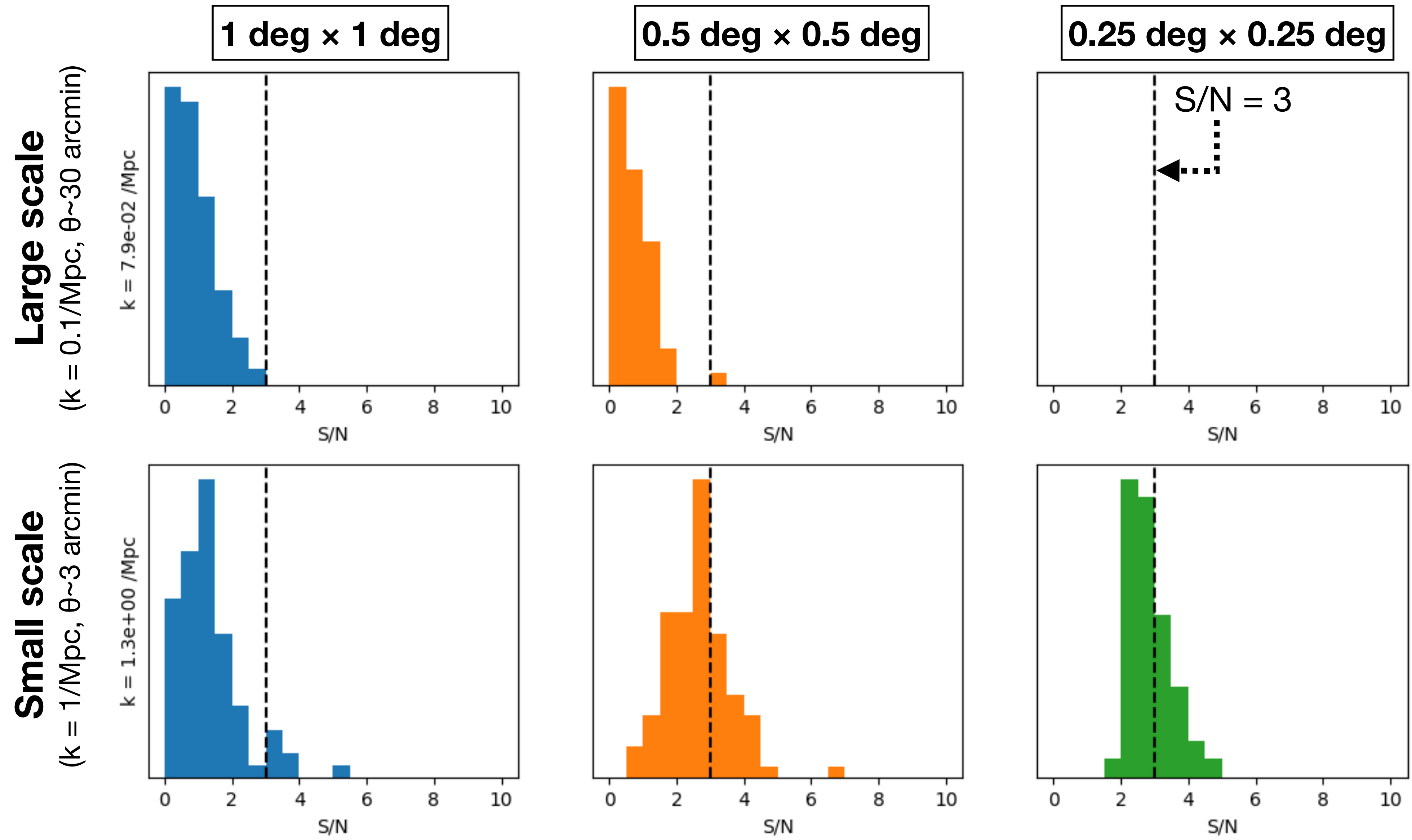**0.25 deg × 0.25 deg**

Error: Jackknife

Results depend on noise realization

S/N distribution for 100 noise realizations (LF)

S/N distribution for 100 noise realizations (HF)

Summary

S/N prediction based on the updated mapping speed

- S/N ~ 10 for LF band (z~2 signals-dominated)

- S/N ~ 3 for HF band (z~2 signals-dominated, but also incl. z~6 [CII])

- The detectability varies depending on the noise realization. We also need to study **dependences on emissivity models and cosmic variance effects** (currently using a fiducial emissivity model and "typical" field" in the Universe)

- **Better to observe deeper with a smaller region** to have some signals for HF (i.e., a hint for z~6 [CII])
  — This is also true for individual detection

- We might need to consider **cross-correlation or stacking** for robustly detecting high-z [CII] signals.